Laser Safety Briefing

Health Physics Office

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Light

Amplification by

Stimulated

Emission of

Radiation

Laser

Laser Applications

- Communications - transmission of voice and image data on fiber optic cable
- Industry - cutting, drilling, welding, guiding, measuring
- Medicine - microsurgery, laboratory applications

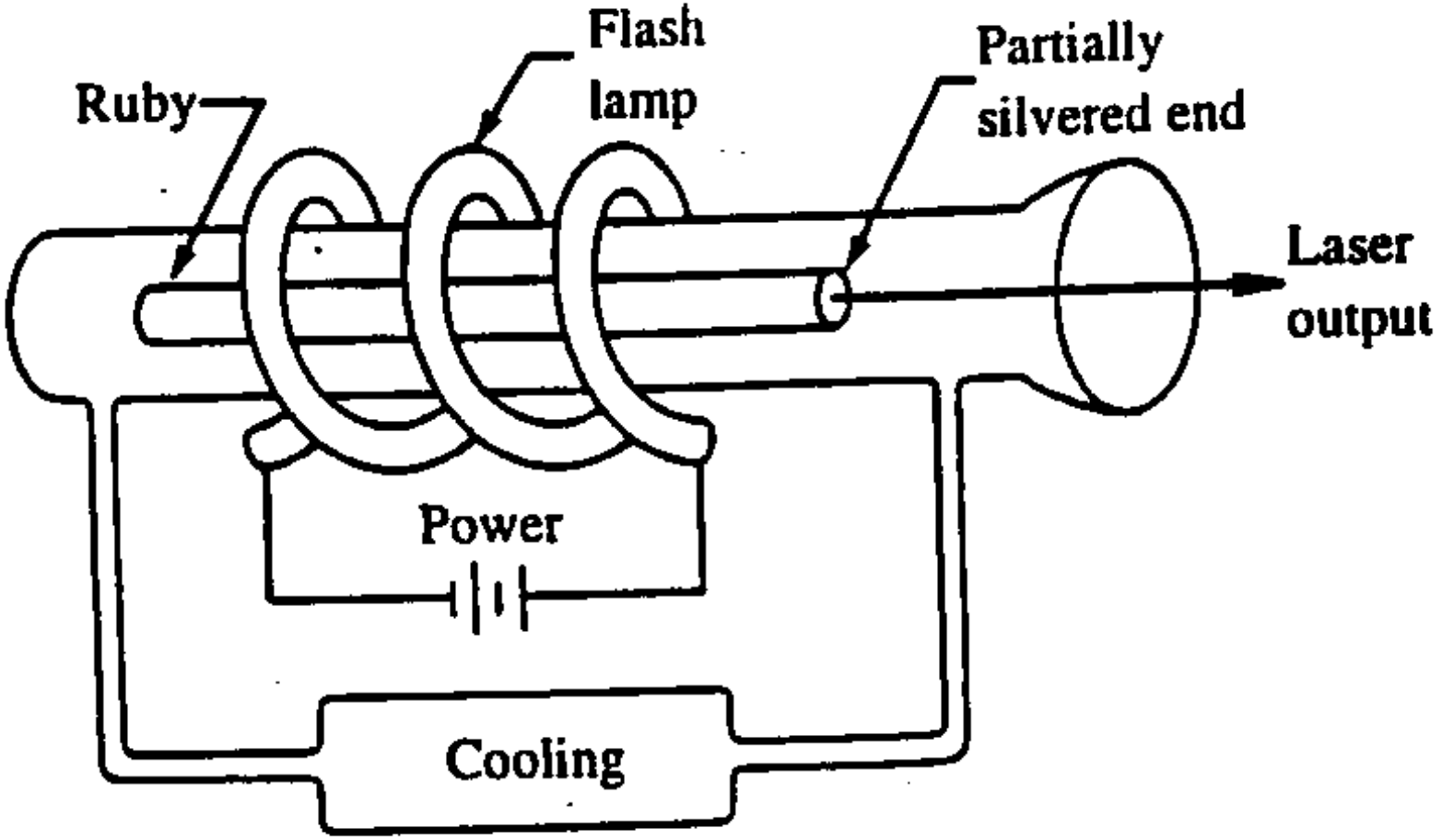
Laser Characteristics

- Narrow, intense beams
- Monochromatic (one color)
- Coherent (light waves in phase)
- Continuous (headlight beam) or pulsed (strobe light)

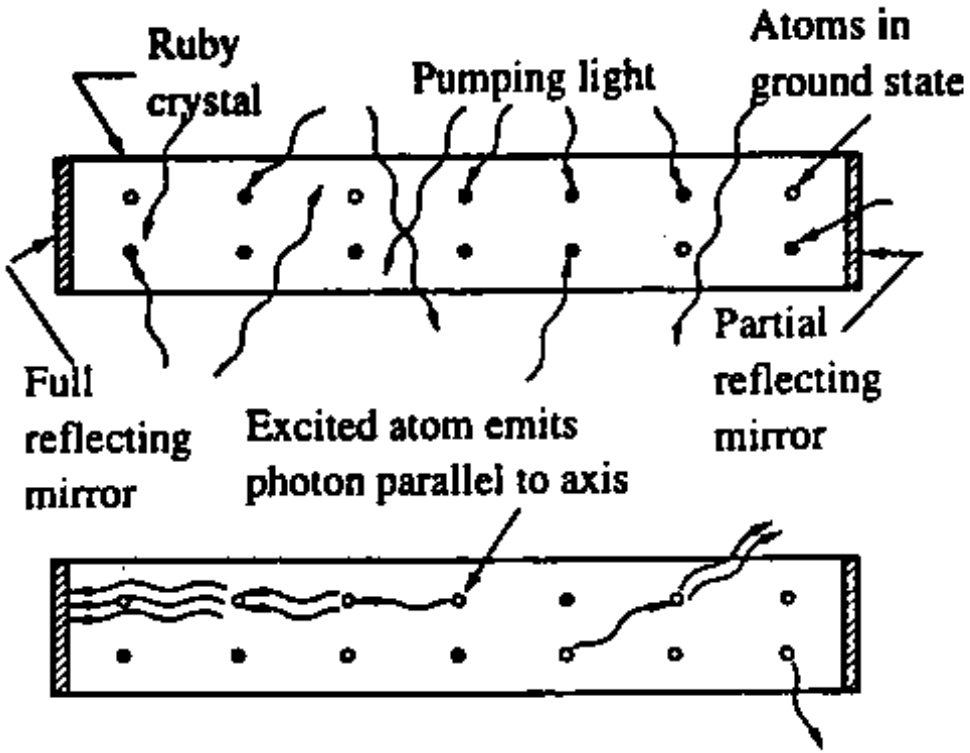
Laser Components

- Pumping system (energy source)
- Lasing medium (gas, liquid, or solid)
- Resonant cavity (amplifies intensity of light)

Ruby Laser


Ruby
Flash lamp
Partially silvered end
Laser output
Power
Cooling

Light Production



Laser Interactions

- Reflection
  - laser beam reflected off shiny surface
- Scattering
  - beam diverges as it contacts surface
- Transmission
  - beam penetrates through material with little or no effect
- Absorption
  - target absorbs light, causing thermal effect

Nominal Hazard Zone (NHZ)

- Area around laser in which there exists a danger to personnel.
- Example: Operating Room in which lasers are being used.
- Protective measures required in NHZ.

Laser Hazard Classification

- Class 1 - exempt laser, no risk.

  Example: office equipment.
- Class 2 - low power, low risk. Visible lasers, direct beam long duration (10 - 20 seconds) viewing hazard.

  Example: Code readers, positioning lasers.

Laser Hazard Classification

- Class 3 - moderate power, moderate risk. Intra-beam and specular reflection viewing hazard.
  - Class 3a - Not hazardous unless viewed with magnification optics
  - Class 3b - Hazardous w/o magnification optics

Laser Hazard Classification

- Class 4 - High power, high risk. Eye and skin hazard even in diffuse reflection. Can cause fires in flammable materials. Many medical lasers fall into this category.

Biological Effects

- Skin - generally considered secondary to eye effects.
  - Requires exposure with high power laser.
  - Effects generally reversible.

Biological Effects

- Eye injury
  - Type of injury depends on type of laser
  - Must view laser light with unprotected eye, or through magnification optics
  - Central vision is affected only if beam is viewed directly

Biological Effects

- Eye injury
  - Retina - scotoma, hemorrhagic lesion,thermal lesion, flash blindness, glare or dazzle
  - Cornea - photokeratitis, opacities, cataracts
  - Intermediate structures - damage to lens and iris can also occur

Other Hazards

- Fire
- Electricity
- Laser Generated Airborne Contaminants
  - toxic compounds
  - bio-aerosols
  - cellular material
  - viruses
- Blood-borne pathogens

Injury Experience

Eye Injury

		Percent
Injury	Permanent Injury	68
	Temporary impairment	18.7
	"no harm"	13.3
Event/procedure	During alignment	35.7
	Laboratory	17.8
	To bystanders	14.1
Environment	Industrial	58.1
	Medical	14.1
	Out-of-doors	11.6
	Educational	16.2

Injury Experience

Skin Injury

		Percent
Injury	Permanent Injury	2.3
	Temporary impairment	93.5
	"no harm"	4.3
Event/procedure	During alignment	17.4
	Laboratory	2.2
	To bystanders	6.5
Environment	Industrial	43.5
	Medical	50
	Out-of-doors	4.3
	Educational	2.2

Laser Safety

- Posting and labeling
- Training and qualification
- Anodized surgical instruments
- Equipment maintenance and calibration
- Protective eyewear
  - Specific to type of laser.
  - Must be engraved

Laser Safety

- One operating switch (pedal)
- Smoke evacuators, surgical masks
- Universal precautions

Questions?

The End!